

Part 1. A time-series study of ambient air pollution and daily mortality in Shanghai, China

Author(s): Kan H, Chen B, Zhao N, London SJ, Song G, Chen G, Zhang Y, Jiang L,

Committee HEIHR

Year: 2010

Journal: Research Report (Health Effects Institute) (154): 17-78

Abstract:

Although the relation between outdoor air pollution and daily mortality has been examined in several Chinese cities, there are still a number of key scientific issues to be addressed concerning the health effects of air pollution in China. Given the changes over the past decade in concentrations and sources of air pollution (e.g., the change from one predominant source [coal combustion], which was typical of the twentieth century, to a mix of sources [coal combustion and motor-vehicle emissions]) and transition in China, it is worthwhile to investigate the acute effects of outdoor air pollution on mortality outcomes in the country. We conducted a time-series study to investigate the relation between outdoor air pollution and daily mortality in Shanghai using four years of daily data (2001-2004). This study is a part of the Public Health and Air Pollution in Asia (PAPA) program supported by the Health Effects Institute (HEI). We collected data on daily mortality, air pollution, and weather from the Shanghai Municipal Center of Disease Control and Prevention (SMCDCP), Shanghai Environmental Monitoring Center, and Shanghai Meteorologic Bureau. An independent auditing team assigned by HEI validated all the data. Our statistical analysis followed the Common Protocol of the PAPA program (found at the end of this volume). Briefly, a natural-spline model was used to analyze the mortality, air pollution, and covariate data. We first constructed the basic models for various mortality outcomes excluding variables for air pollution, and used the partial autocorrelation function of the residuals to guide the selection of degrees of freedom for time trend and lag days for the autoregression terms. Thereafter, we introduced the pollutant variables and analyzed their effects on mortality outcomes, including both mortality due to all natural (nonaccidental) causes and cause-specific mortality. We fitted single- and multipollutant models to assess the stability of the effects of the pollutants. For mortality due to all natural causes, we also examined the associations stratified by sex and age. Stratified analyses by education level, used as a measure of socioeconomic status, were conducted as well. In addition to an analysis of the entire study period, the effects of air pollution in just the warm season (from April to September) and cool season (from October to March) were analyzed. We also examined the effects of alternative model specifications--such as lag effects of pollutants and temperature, degrees of freedom for time trend and weather conditions, statistical approaches, and averaging methods for pollutant concentrations-on the estimated effects of air pollution. We found significant associations between the air pollutants--particulate matter 10 pm or less in aerodynamic diameter (PM10), sulfur dioxide (SO2), nitrogen dioxide (NO2), and ozone (O3) -and daily mortality from all natural causes and from cardiopulmonary diseases. The increased mortality risks found in the data from Shanghai were generally similar in magnitude, per concentration of pollutant, to the risks found in research from other parts of the world. An increase of 10 microg/m3 in 2-day moving average concentrations of PM10, SO2, NO2, and O3 corresponded to 0.26% (95% confidence interval [CI], 0.14-0.37), 0.95% (95% CI, 0.62-1.28), 0.97% (95%

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CI, 0.66-1.27), and 0.31% (95% CI, 0.04-0.58) increases, respectively, in mortality due to all natural causes. Sensitivity analyses suggested that our findings were generally insensitive to alternative model specifications. We found significant effects of the gaseous pollutants SO2 and NO2 on daily mortality after adjustment for PM10. Our analysis also provided preliminary, but not conclusive, evidence that women, older people, and people with a low level of education might be more vulnerable to air pollution than men, younger people, and people with a high level of education. In addition, the associations between air pollution and daily mortality appeared to be more pronounced in the cool season than in the warm. We concluded that short-term exposure to outdoor air pollution (PM10, SO2, NO2, and O3) was associated with daily mortality in Shanghai and that gaseous pollutants might have independent health effects in the city. Overall, the results of the study appeared largely consistent with those reported in other locations worldwide. Further research will be needed to disentangle the effects of the various pollutants and to gain more conclusive insights into the influence of various sociodemographic characteristics (e.g., sex, age, and socioeconomic status) and of season on the associations between air pollution and daily mortality.

Resource Description

Exposure: M

weather or climate related pathway by which climate change affects health

Air Pollution, Meteorological Factors

Air Pollution: Interaction with Temperature, Ozone, Particulate Matter, Other Air Pollution

Air Pollution (other): SO2, NO2

Geographic Feature: M

resource focuses on specific type of geography

Urban

Geographic Location: M

resource focuses on specific location

Non-United States

Non-United States: Asia

Asian Region/Country: China

Health Impact: M

specification of health effect or disease related to climate change exposure

Cardiovascular Effect, Morbidity/Mortality, Respiratory Effect

Cardiovascular Effect: Other Cardiovascular Effect

Cardiovascular Disease (other): cardiovascular mortality; stroke mortality

Respiratory Effect: Chronic Obstructive Pulmonary Disease, Other Respiratory Effect

Respiratory Condition (other): respiratory mortality; COPD mortality; respiratory infection mortality

Population of Concern: A focus of content

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Population of Concern: ☑

populations at particular risk or vulnerability to climate change impacts

Elderly, Low Socioeconomic Status

Resource Type: M

format or standard characteristic of resource

Research Article

Timescale: **™**

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ™

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content